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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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09/922,122

08/03/2001

Hugues Marchand

G&C 30794.79-US-U1

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05/14/2007

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EXAMINER

SONG, MATTHEW J

ART UNIT

PAPER NUMBER

1722

MAIL DATE

DELIVERY MODE

05/14/2007

PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

## Office Action Summary

Application No.

09/922,122

Applicant(s)

MARCHAND ET AL.

Examiner

Matthew J. Song

Art Unit

1722

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 01 March 2007.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1,2,4-9,11-35 and 38 is/are pending in the application.
- 4a) Of the above claim(s) 18-34 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1, 2, 4-9, 11-17, 35 and 38 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |  |   |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)                     | 4) <input type="checkbox"/> Interview Summary (PTO-413)           |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____                                      |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)          | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____  | 6) <input type="checkbox"/> Other: _____                          |

## **DETAILED ACTION**

### ***Election/Restrictions***

1. This application contains claims 18-34 are drawn to an invention nonelected with traverse in Paper filed on 11/12/2002. A complete reply to the final rejection must include cancellation of nonelected claims or other appropriate action (37 CFR 1.144) See MPEP § 821.01.

### ***Claim Rejections - 35 USC § 102***

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. Claims 1-2, 4-9, 15-17, 35 and 38 are rejected under 35 U.S.C. 102(e) as anticipated by Tischler et al (US 6,765,240).

Tischler et al discloses a semiconductor film of M\*N formed on a substrate. Tischler et al also discloses the using a silicon substrate (col 4, ln 50-60 and col 8, ln 10-35) and the M\*N can be a single crystal material comprising a compositionally graded ternary metal nitride selected from the group consisting of AlGaN and InGaN (col 13, ln 1-5), this reads on applicant's single crystal graded gallium nitride layer having a substantially varying composition of a substantially continuous grade from an initial composition to a final composition.

Tischler et al is silent to the graded gallium nitride layer has a net compressive stress. It is inherent to Tischler et al that the graded gallium nitride layer has net compressive stress because the differences in the lattice constant throughout the graded layer on a silicon substrate inherently cause compressive stress. Also, Tischler et al discloses single crystal has no defects from thermal coefficient of expansion differences, i.e. cracks (col 12, ln 45-65 and col 13, ln 1-5), which is further evidence that there is a net compressive stress because applicant's teach that crack free graded GaN has a net compressive stress, note page 8, lines 1-10 of the specification.

Referring to claims 2, 4-9, and 35, the claims are product by process claims and are not limited to the manipulations of the recites steps, only the structure of the implied steps. Even though product-by-process claims are limited by and defined by the process, determination of the patentability is based on the product itself. If the product in the product by process claim is the same or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process (MPEP 2113). Tischler et al discloses a semiconductor film comprising all of the claimed structural features of the product.

Referring to claim 15, Tischler et al discloses forming microelectronic structures on the M\*N, which include LEDS, lasers, transistors etc., this reads on applicant's additional layer disposed on the graded layer.

Referring to claim 16-17, Tischler et al discloses the M\*N material may be doped with Si and the M\*N material may be an AlGaInN compositionally graded compound (col 12, ln 30-45 and col 9, ln 1-15), this reads on applicant's other element is silicon or indium.

Referring to claim 38, Tischler et al discloses the GaN material has no defects from thermal coefficient of expansion difference, this reads on applicant's graded gallium nitride has a

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net stress below a stress required for crack generation in the graded gallium nitride layer because the material contains no defects, including cracks.

***Claim Rejections - 35 USC § 103***

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

5. Claims 11-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tischler et al (US 6,765,240) as applied to claims 1-2, 4-9, 15-17, 35 and 38 above, and further in view of Redwing et al (US 5,874,747).

Tischler et al teaches all of the limitations of claim 11, as discussed previously, except Tischler et al does not teach the initial composition comprises substantially at least 20% aluminum composition.

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In a method of making gallium nitride, note entire reference, Redwing et al teaches the quality of a GaN layer grown on a lattice mismatched substrate such as SiC or Si is greatly improved when a buffer or transition layer is grown on the substrate prior to growth of the GaN layer (col 4, ln 60-65). Redwing et al also teaches a buffer structure which eliminates cracking comprising a compositionally graded (Al,Ga)N buffer layer between a substrate and a GaN epi-layer. Redwing et al also teaches using a graded buffer layer gradually varies the lattice constant and thermal expansion coefficient from that of AlN to that of GaN (col 18, ln 35 to col 19, ln 25). Redwing et al also teaches using an AlGa<sub>x</sub>N buffer where the Al composition is graded from 1 at the substrate interface to 0 at the GaN interface (col 18, ln 60 to col 19, 10 and col 24, ln 55-67) to eliminate cracking of GaN epi-layers, this clearly suggests applicant's initial composition is at least 20% aluminum composition and the final composition comprises substantially less than a 20% aluminum composition.

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Tischler et al by using an initial composition rich in Al and a final composition with no Al, as suggested by Redwing et al, to produce a GaN layer free of cracking by reducing lattice mismatch using a graded buffer layer.

Referring to claims 12-14, the combination of Tischler et al and Redwing et al teaches an initial composition of AlN and a final composition of GaN, this clearly suggests applicant's initial composition is at least 20% aluminum composition and the final composition comprises substantially less than a 20% aluminum composition.

***Response to Arguments***

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6. Applicant's arguments filed 3/1/2007 have been fully considered but they are not persuasive.

Applicant's argument that Tischler does not teach a structure with a net compressive stress is noted but is not found persuasive. Applicant alleges that Tischler teaches immediate removal of the substrate without cooling down the structure to room temperature, thus the structure would not have a net compressive stress because the substrate is only present at the growth temperature. Tischler does not require removal at the growth temperature. Tischler teaches the etch removal is carried out at a temperature within 300°C of the growth temperature and removal at a temperature of 700°C which is below the growth temperature of 1000-1100°C (col 6, ln 50-65 and col 8, ln 40-45).

Applicant's argument regarding the Examiner's secondary suggestion of inherency is noted but not found persuasive. Applicant clearly teaches that crack free graded GaN has a net compressive stress, not page 8, lines 1-10 of the specification. While Tischler does teach removing the silicon substrate at a temperature near the growth temperature, as suggested by applicant, Tischler also teaches using SiC as an etch stop layer (col 11, ln 35-45), which is not removed and the GaN still exhibits a defect free (crack free) surface (col 12, ln 45-60).

Applicant's argument that Tischler's end product does not have a silicon substrate is noted but is not found persuasive. Tischler intermediate product, the silicon substrate and GaN graded layer prior to removing the substrate, reads on applicant's claimed invention. The fact that Tischler teaches a subsequent step where the substrate is removed does not take away from Tischler's teachings.

Applicant's primary arguments appear to suggest that Tischler's structure does not exhibit a net compressive stress at high temperatures. However, there is no rebuttal that

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Tischler's structure exhibits a net compressive stress at a high temperature. The structure taught by Tischler is similar to the structure taught by Applicant. Tischler teaches a graded GaN layer on a silicon substrate. While the differences in thermal expansion coefficient are a factor. The differences in lattice constant also affect the compressive strain, as evidenced in paragraph [0025] of applicant's specification which discussed elastic energy associated with the lattice mismatch of materials. Tensile stress is induced by the cool down but at the high temperatures the compress strain by the mismatch in lattice constant would still be present. The temperature only affects the thermal expansion coefficient and would have no affect on the compressive stress caused by the mismatch in lattice constant in the graded layer. Therefore, at the higher temperature before the cool down process which induced tensile stress, the net stress would be compressive because there would be no tensile stress to counterbalance.

### ***Conclusion***

**7. THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event,



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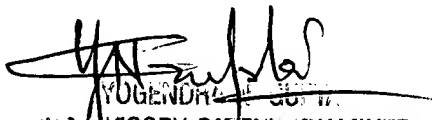
however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew J. Song whose telephone number is 571-272-1468. The examiner can normally be reached on M-F 9:00-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Yogendra Gupta can be reached on 571-272-1316. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Matthew J Song  
Examiner  
Art Unit 1722

  
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SUPERVISORY PATENT EXAMINER  
TECHNOLOGY CENTER 1700

MJS  
May 8, 2007